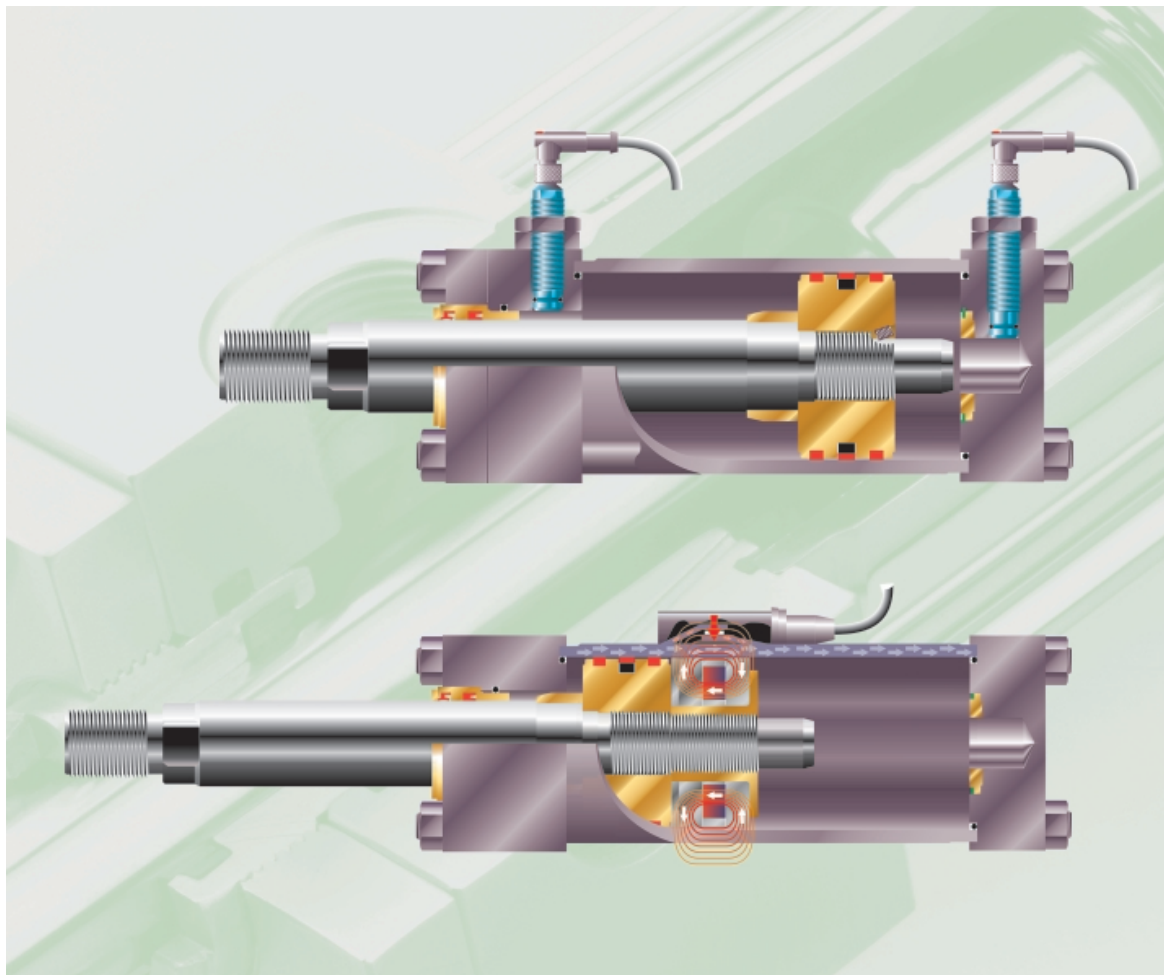


Position Switches

For Tie Rod and Roundline Cylinders

Catalogue 0810/3-UK



Contents

Introduction	2
Operating Principles	3
Application	3
Selection Guide	3
Read.me Switches	
Construction	3
Operating Principle	4
Performance	4
Positioning	5
Specification	5
Installation	5
Model Numbers and Ordering	5
End of Stroke Switches	
Introduction	6
Mounting Data	7
Dimensions	8
Installation	9
Technical Data	10
Ordering	10
Applications Data	11

Page

Index

Application	3
Build Length	4
Cabling	5, 6
CE Marking	3
Connectors	6
Connection – Series and Parallel	11
Cushioning	6
Dimensions	4, 8
Installation	5, 7, 9
Introduction	2, 3, 6
Model Numbers	5, 10
Mounting Configurations	7
Mounting Styles	5
Operating Principles	3, 4
Ordering	5, 10
Performance	4
Positioning	5
Protective Covers	5
Selection Guide	3
Short Circuit Protection	6
Specification	5, 10
Stroke Adjusters	6

Page

Parker Hannifin

Parker Hannifin Corporation is a world leader in the manufacture of components and systems for motion control. Parker has more than 800 product lines for hydraulic, pneumatic and electro-mechanical applications in some 1200 industrial and aerospace markets. With more than 35,000 employees and some 200 manufacturing plants and administration offices around the world, Parker provides customers with technical excellence and first class customer service.

Parker Hannifin's Cylinder Division is the world's largest supplier of hydraulic cylinders for industrial applications. Parker cylinders are used in applications as diverse as machine tools, flight simulation and tidal barrier control.

inPHorm

European Cylinder inPHorm is Parker Hannifin's new product selection program that helps you to select the correct part for an application. The program prompts for the details of the application, makes the necessary design calculations, and selects a suitable product. inPHorm can generate CAD drawings of the selected cylinder, which can be viewed in other software applications, and customised and imported into other CAD packages. Please contact your local Sales Office for further information.

Introduction

Position switches provide a versatile and cost-effective means of monitoring piston position in a hydraulic cylinder. The switching signal which they generate can be used to control or sequence actions which correspond to specific points in a production cycle or process, as determined by the position of the cylinder's piston. Parker's position switches are rugged units designed for industrial use, and their performance has been proven over millions of cycles of testing and in the harsh operating environments of manufacturing industry.

Parker offers two types of position switch – an End-of-Stroke switch which mounts in the head and/or cap of the hydraulic cylinder, and the Read.me switch – a mid-stroke design which clamps to the body of the cylinder in a position determined by the user. Both types of switch are 'designed in' to the cylinder and must be specified at the time of order.

The position switches described in this catalogue have been designed for service in steel mills, plastic injection moulding plants and other applications where rugged, dependable equipment is required. In addition to the standard designs featured in this catalogue, position switches can be adapted to suit individual customer requirements. Our engineers will be pleased to discuss and advise on unique designs to suit specific applications. Position switches are available for the following cylinder ranges:

- HMI/HMD – 210 bar metric tie rod cylinders
- 2H – 210 bar inch series tie rod cylinders
- 3L – 70 bar inch series tie rod cylinders
- 2A – 18 bar inch series pneumatic tie rod cylinders
- MMA – 250 bar metric roundline cylinders
- MMB – 160 bar metric roundline cylinders

Note: In line with our policy of continuing product improvement, specifications in this catalogue are subject to change without notice.

Why Use Position Switches?

- enhance the versatility of a hydraulic cylinder
- provide reliable and accurate position sensing
- simpler and less costly than a feedback transducer
- mid-stroke switches can be adjusted to suit different production processes
- can provide safety interlocks in critical applications
- integral LEDs provide continuous visual monitoring
- non-contacting designs have no wearing parts
- suitable for tough operating conditions

Operating Principles

End-of-Stroke switches are inductive-type designs, fitted to the cylinder's head and/or cap. On cushioned cylinders, switches are actuated by the presence of the cushion sleeve and spear at each end of the cylinder's stroke. On non-cushioned cylinders, the sleeve and spear are also fitted but by-pass orifices are added at the head and cap to overcome the cushioning effect.

Read.me switches employ a sensor clamped to the cylinder tube, and magnets attached to the piston. The flux of these permanent magnets, as they pass the sensor, induces a temporary change of polarity in the sensor, and it is this change of polarity which provides the switching effect.

Parker's End-of-Stroke and Read.me position switches are available for both cushioned and non-cushioned cylinders.

CE Marking

The position switches fitted by Parker are CE marked to certify that they meet the requirements of the EU Directive 89/336/EEG for electromagnetic compatibility.

Application

The differing designs and performance parameters of the two switch types determine their suitability for different applications. While End of Stroke switches register a fixed point at the beginning and/or end of piston travel, Read.me switches allow mid-stroke positions to be chosen by the user for switching and sequencing operations.

Switching by the Read.me switch sensor occurs as the piston enters a switching 'zone'. The switching point is highly repeatable, in either direction, under conditions of constant piston speed and operating temperature. The switching zone may be up to 50mm wide depending on cylinder tube wall thickness and piston speed. Because of the physical size of the sensor, and the magnet carrier's location offset to one side of the piston – see figures 1 & 2 on page 4 – the point at which this switching zone begins does not allow end-of-stroke switching at the cap end of the cylinder. Where switching at or close to the cap end is critical, machine designers should contact our Engineering department so that a custom solution can be developed.

Parker's versatile clamping mechanism allows the position of the Read.me sensor to be adjusted, permitting the same cylinder to be adapted to different processes and operations. The number of Read.me switches which can be fitted is restricted only by available mounting space on the cylinder tube.

Position Switch Selection Guide

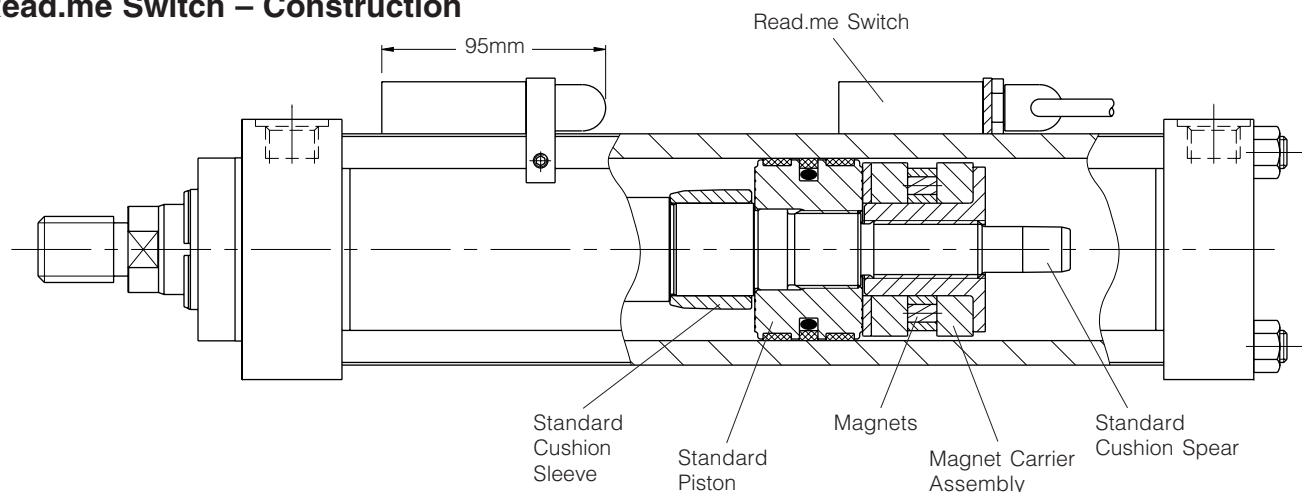
Switch Type	Senses Position at			Can Register Multiple Positions	Position Adjustable by User	Bore sizes available (mm)				Mounting Styles Available	Protective Covers Available
	End of Stroke	Close to End of Stroke	Mid-stroke			HMI/HMD	2H, 3L, 2A	MMB	MMA		
End of Stroke	✓	✗	✗	✗	✗	32-200	38.1-203.2	All	All	All	C/F
Read.me	Head ✓ Cap - C/F	Head ✓ Cap - C/F	✓	✓	✓	32 -125 ¹	C/F	40 -125 ¹	50 -125 ¹	All ²	✓

C/F – consult factory

¹ For larger and smaller bore cylinders, please consult factory

² Switch position may be restricted on mountings DD (HMI/HMD) and MS2 and MT4 (MMA and MMB) – see pages 4 and 5.

Read.me Switch – Construction



Read.me Position Switches

– Operating Principle

Parker's Read.me switches detect the change in polarity of a magnetic field which occurs when the magnetic field of one magnet interacts with the flux of a second, more powerful magnet. In the Read.me switch, permanent magnets attached to the cylinder piston induce a residual magnetism in the tube as they travel along its length. The sensor detects and adopts the polarity of the tube – see figure 1.

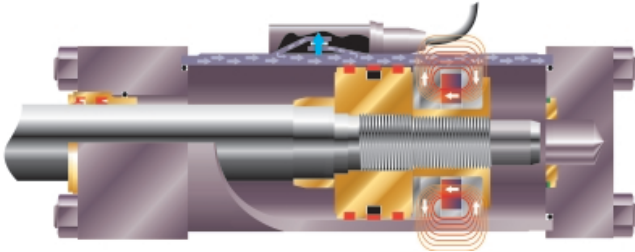


Figure 1

On the return stroke, the greater strength of the moving magnetic field prevails over the residual magnetism of the switch and causes a change of polarity – see figure 2.

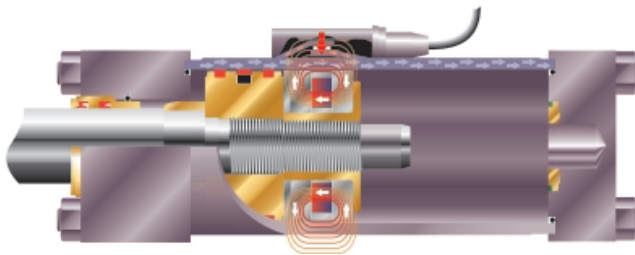


Figure 2

This switching effect enables the position of the piston in a cylinder to be monitored, allowing external controls and processes to be linked to piston position.

LEDs incorporated into the switch housing allow the user to visually monitor the switching point.

Performance

Parker's Read.me switches have been designed to operate at a maximum piston speed of 0.5m/s, and a maximum cylinder temperature of 80°C. Exceptions to these figures are as follows:

MMA

50mm, 80mm and 100mm bore cylinders:

- At max. temp. 80°C, piston speed should not exceed 0.2m/s.
- At max. temp. 50°C, piston speed should not exceed 0.5m/s.

MMB

100mm bore cylinders:

- At max. temp. 80°C, piston speed should not exceed 0.2m/s.
- At max. temp. 50°C, piston speed should not exceed 0.5m/s.

Designs for use at higher speeds and/or temperatures are available to special order. Our engineers will be pleased to discuss and advise on unique designs to suit specific applications.

All dimensions are in millimetres unless otherwise stated.

Operating Range

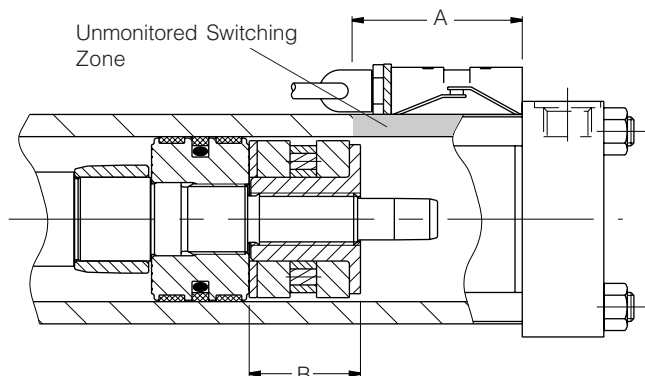
Read.me switches provide highly repeatable position switching at intermediate stroke positions of a cylinder. They clamp to a cylinder tie rod and are infinitely adjustable between the cylinder's head and cap ends. Because the switching effect occurs within a 'zone' rather than at a single point, see 'Application' on page 3, Read.me switches are not suitable for position switching close to the cap end of a standard cylinder. The length of stroke 'A' which cannot be monitored using a Read.me switch is shown in the table and diagram below, and is measured from the fully retracted (cap end of stroke) position. Where switching within this zone is required, please contact our Engineering department to discuss a custom solution.

Bore Size	Unmonitored Switching Zone - A				
	HMI/HMD	MMA		MMB	
	All styles, cap end	All styles excl. MS2	MS2 only	All styles excl. MSP	MSP only
32	46	N/A	N/A	N/A	N/A
40	46	N/A	N/A	54	68
50	38	80	80	47	67
63	38	75	75	47	61
80	35	76	87	43	64
100	35	76	91	43	69
125	34	75	80	42	68

Additional Build Length

The addition of the magnet carrier to the piston increases the build length 'B' of cylinders equipped for Read.me switches. The additional lengths shown in the table and diagram below should be added to all the stroke dependent lengths of the cylinders, as listed in the individual product catalogues – see page 2.

Bore Size	Increase in Build Length - B		
	HMI/HMD	MMA	MMB
32	33	N/A	N/A
40	33	N/A	33
50	43	43	43
63	43	43	43
80	48	48	48
100	48	48	48
125	48	48	48

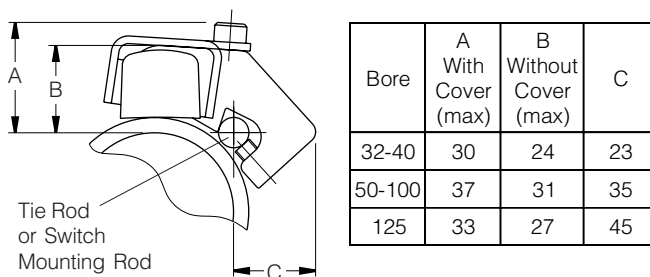


Cylinder Mounting Styles

Read.me switches are suitable for use with all mounting styles. Note, however, that the positioning of the switches can be restricted by the trunnion body on centre trunnion designs DD (HMI/HMD) and MT4 (MMA and MMB), and by the foot mounting flanges on MS2 (MMA) and MSP (MMB) cylinders. Where switching is required in these restricted areas, custom solutions may be available – please contact our Engineering department.

Positioning

Read.me switches can be fitted to either side of a tie rod, allowing switching zones to be positioned close together if desired. Note that, where switch orientation is reversed, the action of the status LEDs will also be reversed. The total number of Read.me switches which can be fitted to a cylinder is restricted only by available mounting space.



On a tie rod cylinder, any of the structural tie rods may be used to mount Read.me switches.

On roundline cylinders MMA and MMB, a switch mounting rod (or rods) is added during manufacture to permit attachment of the switches. Unless otherwise specified, this rod will be fitted at 90° to the head port position, ie: in position 2 as illustrated on page 7. Where an alternative switch mounting rod position is required, this should be specified at the time of order.

Protective Covers

Read.me switches are available with the option of protective covers, for use where the switch or its connector could be vulnerable to damage. The covers attach to the clamp bracket and fit over Parker's standard right-angled connectors.

Specification

Switch output	antivalent pnp
Switch zone	50mm typical
Switch hysteresis	5mm typical
Repeatability	0.5mm typical
Supply voltage	10-30V DC
Load current	100mA
Current consumption	30mA
Voltage drop	1.5V
Short circuit protection	Timed
Reverse polarity protection	Polarity protected
Protection per DIN 40050	IP67
Connection	detachable 4 pin round connector
Cable length	5m

Cabling

Position switch cabling should be routed separately from cables carrying high currents or cables wired to inductive loads, as these could interfere with the signal.

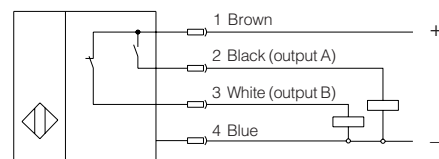
Installation

A robust alloy bracket holds the Read.me switch against the cylinder tube, and clamps to the tie rod or mounting rod with a set screw. Releasing the set screw allows the switch to be repositioned at any point on the cylinder tube. Read.me switches are supplied with a right-angled connector fitted with five metres of cable, which may be cut to length.

To establish switch position relative to piston or process position, proceed as follows.

- 1 Connect the Read.me switch connector to the switch body and to the control unit/power supply.
- 2 Cycle the cylinder to 'format' the residual magnetism of the tube, and advance the cylinder piston to the position at which switching is to occur.
- 3 Position the Read.me switch and clamp on the cylinder tie rod or mounting rod. Do not tighten the set screw at this stage.
- 4 With power supplied to the switch, move the switch body along the tie rod or mounting rod until the switching position can be established using the switch status LED. Depending on the switch status required, move the switch until the status LED has just illuminated or just cut out.
- 5 Tighten the set screw against the tie rod or mounting rod, and cycle the cylinder at operating speed to confirm switching position. If adjustment is necessary, slacken the set screw slightly, reposition the switch and re-tighten.

Connector Wiring



Model Numbers and Ordering

To order a cylinder with Read.me switches, the standard cylinder model code should be used. Under 'special features', an 'S' should be inserted and the appropriate information from the following table, including quantities, should be added.

Note: For MMA/MMB cylinders only, the position of the mounting switch rod(s) relative to head port position must be stated.

Read.me Switch Kit Numbers	
Switch Kit, Bore Sizes 32-40mm	PS100
Switch Kit, Bore Sizes 50-100mm	PS101
Switch Kit, Bore Size 125mm	PS102
Protective Cover (all models)	PS103

Example

An MMB cylinder with two Read.me position switches and protective covers mounted at 180° from the port; ports in position 1 and air bleeds in position 4:

100 C MF3 MMB R E S 1 4 M C 250 M 11 44
 S = two off PS101 plus two off PS103; switch mounting rod at 180° from port position

All dimensions are in millimetres unless otherwise stated.

Introduction

Introduction to End of Stroke Position Switches

Parker's End of Stroke position switches are pressure tested to 500 bar. They are unaffected by vibration, dust or oil and, because they are built into the cylinder, are partly protected from physical damage. Where required, steel covers can be supplied to protect the exposed connector. End of Stroke position switches will operate reliably to within 100mm of resistance welding tips.

End of Stroke position switches are non-contacting, inductive-type switches. They are available for cushioned and non-cushioned cylinders with a stroke length over 15mm, and can be supplied for the head and cap ends of the cylinder.

The point at which the switches operate varies for different cylinder configurations, at between 1.0mm and 4.0mm from the end of stroke. The switching point for a particular cylinder is repeatable within 0.5mm.

Cylinders with Cushions

On cushioned cylinders, End of Stroke switches are actuated by the presence of the cushion sleeve or the cushion spear at the end of the cylinder's stroke. On non-cushioned cylinders, the sleeve and spear are also fitted but by-pass orifices are added at the head and cap to overcome the cushioning effect.

The combination of cushions and End of Stroke position switches on a cylinder with one of the following mounting styles requires a special design. Where one of these combinations is required, please contact the factory.

Style D – with a cushion at the head end
Style DB – with a cushion at the cap end

Cylinders with Stroke Adjusters

End of Stroke position switches are not available at the cap ends of cylinders fitted with stroke adjusters.

Short-Circuit Protection

A bi-stable type of short circuit protection prevents damage to the End of Stroke position switch through overload or short-circuit.

If a short circuit occurs, the output transistor is turned off. When the short circuit is removed, the switch will operate normally again if either the power supply is momentarily interrupted, or if the switch is operated by movement of the piston rod from the end of stroke position. The cause of the short circuit must be removed to prevent recurrence.

Note: End of Stroke position switches are low current, solid state devices using PNP switching. Care must be taken to prevent overloading on connection. Position switches must not be connected directly to low resistance loads as these would cause the short circuit protection to operate.

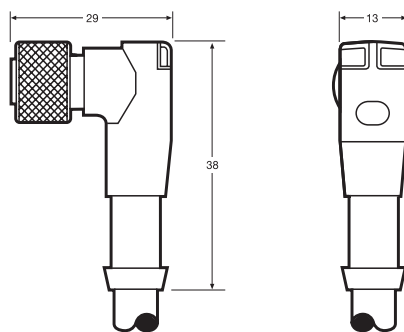
End of Stroke Position Switches

Connector Types

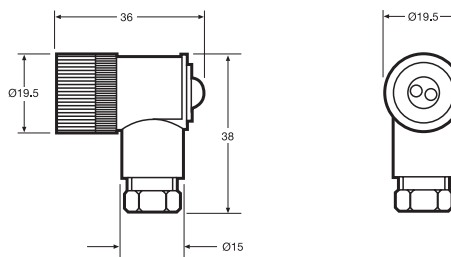
The standard DC End of Stroke position switch is supplied with a screw-type connector, part no. PS011, moulded onto five metres of cable which can be cut to length. A screwed collar and keyway ensure correct connector alignment.

An optional connector, part no. PS012, allows the user to fit his own cabling. The connector may be positioned at 90° intervals to the switch body, as required.

Both types of connector are equipped with two LEDs, the first showing 'power on' and the second illuminating when the switch is activated. On the PS012 connector, the LEDs can be connected or left unconnected, as preferred.



Standard Connector PS011



Optional Connector PS012

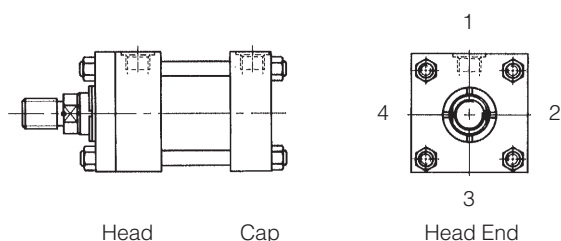
Cabling

Position switch cabling should be routed separately from cables carrying high currents or cables wired to inductive loads, as these could interfere with the signal.

Mounting Configurations

Tie Rod Cylinders

The tables list the standard mounting positions for End of Stroke position switches fitted to tie rod cylinders, **where these positions are not occupied by a port or cushion adjusting screw**. Where the required position is not listed, special designs may be available – please consult the factory.



The drawing shows position switch mounting positions for the cylinder head and cap, as viewed from the rod end. The port is shown in position 1, but can be supplied in other positions depending on the mounting style chosen – see the appropriate product catalogue for details.

HMI/HMD Cylinders – Switch Positions Available

Mounting Style	Bore Size (mm)									
	32	40	50	63	80	100	125	160	200	
C	Head	1, 3	1, 3	1, 3	1, 3	Any				
	Cap									
JJ (HMI)	Head	Any								
	Cap	Any								
JJ (HMD)	Head	1, 3				Any				
	Cap	Any								
HH	Head	Any								
	Cap	Any							1, 3	
D	Head					1, 3				
	Cap	Any								
DB	Head	Any								
	Cap	1, 3								
TB, TC, TD, BB, SBd, DD, B	Any									

2H Cylinders – Switch Positions Available

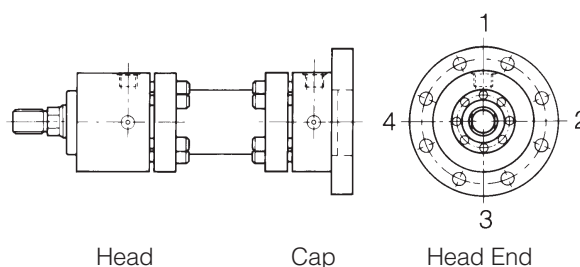
Mounting Style	Bore Size (mm)									
	38.1	50.8	63.5	82.6	101.6	127.0	152.4	177.8	203.2	
C	Head	1, 3	1, 3	1, 3	Any					
	Cap									
J	Head	1, 3	Any							
	Cap	Any								
JB	Head	N/A	Any							
	Cap	Any								
H	Head	Any								
	Cap	1, 3	Any							
HB	Head	Any								
	Cap	N/A	Any							
D	Head	1 or 3, opposite port face								
	Cap	Any								
DB	Head	Any								
	Cap	1 or 3, opposite port face								
T, TB, TC, TD, JJ, BB, DD, SB	Any									
F, G	1, 2 or 4, except port face									
HH	Head	Any								
	Cap	Any								1, 3

3L and 2A Cylinders – Switch Positions Available

Mounting Style	Bore Size (mm)									
	38.1	50.8	63.5	82.6	101.6	127.0	152.4	203.2		
C	Head	1, 3	1, 3	1, 3	Any					
	Cap									
J	Head	1, 3	1, 3	Any						
	Cap	Any								
JB	Head	N/A	Any							
	Cap	Any								
H	Head	Any								
	Cap	1, 3	1, 3	Any						
HB	Head	Any								
	Cap	N/A	N/A	Any						
D	Head	1 or 3, opposite port face								
	Cap	Any								
DB	Head	Any								
	Cap	1 or 3, opposite port face								
T, TB, TC, TD, BB, BC, DD,	Any									
F, G	1, 2 or 4, except port face									

Roundline Cylinders

End of Stroke position switches may be fitted to the heads and caps of MMA and MMB cylinders in any position which is not occupied by a port, or obstructed by the style of mounting chosen. The drawing shows position switch mounting positions for the cylinder head and cap, as viewed from the rod end. The port is shown in position 1, but can be supplied in other positions depending on the mounting style chosen – please consult the factory for details.



Dimensions

End of Stroke Position Switches

How to Use These Dimensions

When specifying a cylinder fitted with End of Stroke position switches, this catalogue should be used in conjunction with the appropriate cylinder catalogue. Most cylinder dimensions do not change with the addition of an End of Stroke position switch, and should be taken from the cylinder catalogue.

Tie Rod Cylinders

Where tie rod cylinder dimensions differ from the basic cylinder, they should be identified from the drawing and tables below.

End of Stroke position switches can be fitted to 25mm bore HMI/HMD series cylinders and 25.4mm bore 3L and 2A series cylinders, depending on the mounting style chosen. Where these sizes are required, please consult the factory with details of the application.

Mounting Dimensions – Series 2H

Bore Ø	Rod No.	Rod Ø	H1 max		A	H2 max		B
			All exc. JJ, Pos'ns 2 & 4	JJ, Pos'ns 2 & 4		All exc. HH, Pos'ns 2 & 4	HH, Pos'ns 2 & 4	
38.1	1	15.9	68.5	73	22.5	62.5	68	14.1
	2	25.4	72.5	77				
50.8	1	25.4	68.5	68	22.5	85.5	105	15.6
	2	34.9	71.5	71				
63.5	1	25.4	86.5	106	22.5	78.5	98	15.6
	2	44.5	71.5	71				
	3	34.9	66.5	66				
82.6	1	34.9	78.5	92	22.3	69.5	82	17.5
	2	50.8	63.5	102				
	3	44.5	83.5	97				
101.6	1	44.5	77.5	90	22.3	66.5	79	19
	2	63.5	65.5	103				
	3	50.8	82.5	95				
127.0	1	50.8	63.5	68	30.3	95.5	55	22
	2	88.9	83.5	89				
	3	63.5	70.5	76				
	4	76.2	77.5	83				
152.4	1	63.5	103.5	57	30.2	87.5	41	25.2
	2	101.6	77.5	76				
	3	76.2	64.5	63				
	4	88.9	71.5	70				
177.8	1	76.2	96.5	46	30.3	79.5	29	26.8
	2	127.0	78.5	65				
	3	88.9	103.5	52				
	4	101.6	64.5	59				
203.2	1	88.9	90.5	35	30.2	68.5	N/A	31.7
	2	139.7	72.5	61				
	3	101.6	96.5	41				
	4	127.0	66.5	55				

Roundline Cylinders

For dimensional changes to roundline cylinders fitted with End of Stroke position switches, please consult the factory.

Mounting Dimensions – Series 3L and 2A

Bore Ø	2A Rod No.	3L Rod No.	Rod Ø	H1 max	A	H2 max	B
38.1	1	1	15.9	74.5	22.1	69.5	10.4
	2	2	25.4	79.5			
50.8	1	1	15.9	71.5	22.1	63.5	10.4
	2	2	34.9	77.5			
	3	3	25.4	74.5			
63.5	3	1	25.4	68.5	22.1	81.5	10.4
	2	2	44.5	77.5			
	4	3	34.9	72.5			
	1	7	15.9	65.5			
82.6	1	1	25.4	86.5	18.5	78.5	10.3
	2	2	50.8	76.5			
	3	3	34.9	66.5			
	4	4	44.5	71.5			
101.6	3	1	34.9	78.5	18.5	67.5	10.3
	2	2	63.5	71.5			
	4	3	44.5	83.5			
	5	4	50.8	63.5			
	1	7	25.4	74.5			
127.0	4	1	44.5	70.5	26.5	99.5	10.3
	2	2	88.9	71.5			
	5	3	50.8	75.5			
	6	4	63.5	83.5			
	7	5	76.2	64.5			
	1	7	25.4	61.5			
	3	8	34.9	66.5			
152.4	3	1	44.5	103.5	18.3	88.5	9.5
	2	2	101.6	64.5			
	4	3	50.8	63.5			
	5	4	63.5	70.5			
	6	5	76.2	77.5			
	7	6	88.9	83.5			
	1	7	34.9	98.5			
203.2	4	1	50.8	82.5	26.3	63.5	9.5
	2	2	139.7	85.5			
	5	3	63.5	90.5			
	6	4	76.2	96.5			
	7	5	88.9	103.5			
	8	6	101.6	64.5			
	1	7	34.9	73.5			
	3	8	44.5	77.5			
	0	0	127.0	78.5			

All dimensions are in millimetres unless otherwise stated.

Mounting Dimensions – Series HMI/HMD

Bore Ø	Rod No.	Rod Ø	H1 max		A	H2 max		B
			All exc. JJ, Pos'ns 2 & 4	JJ, Pos'ns 2 & 4		All exc. HH, Pos'ns 2 & 4	HH, Pos'ns 2 & 4	
32	1	14	80	67	24			8
	2	22	83	70	21	73	61	
40	1	18	75	77	21			14.5
	2	28	77	78	21.5	65	67	
50	1	22	69	66	21			14.5
	2	36	75	73	21.5	83	101	
	3	28	72	69	21			
63	1	28	66	107	21			14.5
	2	45	74	70	21.5	80	97	
	3	36	69	65	21.5			
80	1	36	81	92	21			19.5
	2	56	66	102	29	71	83	
	3	45	85	97	21			
100	1	45	77	87	21			19.5
	2	70	68	102	30	66	76	
	3	56	85	95	28			
125	1	56	68	72	36			21.5
	2	90	86	89	37.5	97	56	
	3	70	75	79	38			
160	1	70	100	52	30			24.5
	2	110	76	73	30	82	35	
	3	90	111	62	30			
200	1	90	91	33	36			26.5
	2	140	73	60	32.5	68	N/A	
	3	110	101	43	33.5			

Switch Installation

There are two alternative methods of installation for End of Stroke position switches, both of which are suitable for use with tie rod or roundline cylinders. Method 1 aligns the connector with the cylinder's centreline, while method 2 may be used where connector alignment is not critical.

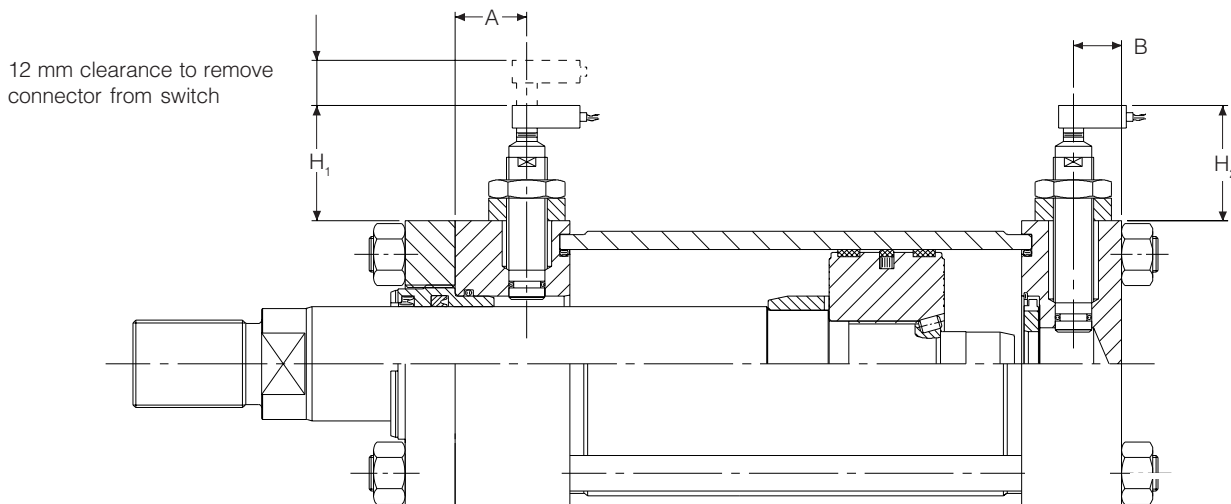
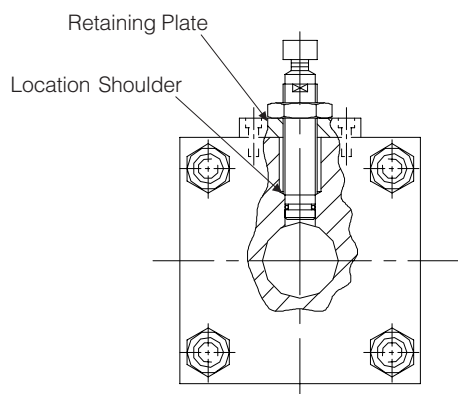
Note: On series 3L and 2A cylinders with No.2 rods and 38.1mm, 50.8mm or 63.5mm bores, an adapter is used to mount the switch, in place of the retaining plate shown. In these cases, method 2 should be used.

Method 1

Hold the End of Stroke switch firmly against its locating shoulder, with the connector aligned with the cylinder's centreline. Screw the retaining plate down until it meets the mounting surface, and then back off until the screw holes align. This will leave a gap of less than 0.5mm under the plate. Torque tighten the two fixing screws evenly to 10Nm.

Method 2

Screw the retaining plate onto the End of Stroke switch, and use the switch for alignment as the plate is fitted to the mounting surface. Torque tighten the two fixing screws evenly to 10Nm. Screw the switch down until the locating shoulder bottoms, and tighten the lock nut to secure in position.



All dimensions are in millimetres unless otherwise stated.

Technical Data & Ordering

End of Stroke Position Switches

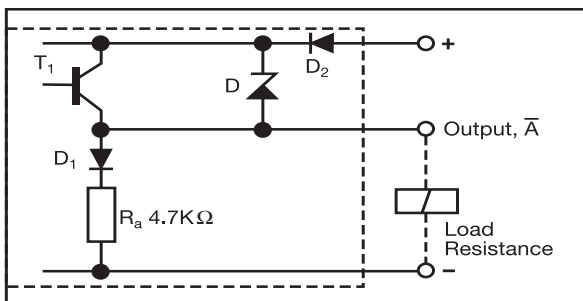
Specifications

The technical data which follows is applicable to the End of Stroke position switches and connectors fitted to both tie rod and roundline cylinders.

The switch is an inductive PNP device, ie: the load is connected to the negative line. The output function is normally open (N/O).

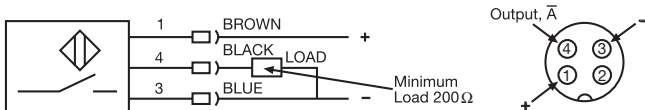
Nominal voltage V_s , including ripple	10-30V DC
Ripple on DC supply	15% max.
No-load current I_o	$\leq 10\text{mA}$
Output resistance R_a and diode	4.7k Ω
Output resistance R_a and diode with standard connector LED	2.2k Ω
Residual voltage at load resistance of 10k Ω (switch open)	0.8V
Voltage drop V_d (switch closed)	$\leq 1.5\text{V}$
Response time	10 μsec . (approx)
Hysteresis	$\leq 0.2\text{mm}$
Rate of rise and fall of output voltage	$\geq 1\text{V}/\mu\text{sec}$
Max. output load current I_m	$= 5 \times V_s \text{ mA}$
eg: at $V_s = 24$, $I_m \text{ max} = 5 \times 24 = 120\text{mA}$	
Min. load resistance R_L min.	200 Ω
Max. load capacitance including cable	150nF
Max. duty cycle	100%
Ambient temperature	-25°C to +70°C
Protection class, housing only	IP 67 (DIN 40 050)
Protection class, with connector	IP 67 (DIN 40 050)
Housing material	Stainless steel to DIN X12CrMoS 17
Peak pressure – switch	500 bar

Schematic Drawing of Switch



- T_1 = output transistor
- R_a = output resistance
- D = Zener diode for peak voltage control with inductive loads
- D_1 = wire leakage diode
- D_2 = reverse polarity protection diode (short circuit protection)

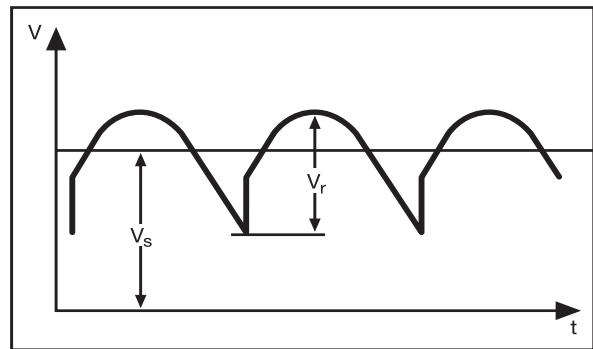
Connector Wiring and LED



Power Supply

Output voltage, including ripple 10-30V DC

Ripple



- V_s = arithmetic average of DC voltage
- V_r = amplitude of AC component voltage

$$\text{Ripple} = \frac{V_r}{V_s} \times 100\%$$

Ripple is the alternating voltage superimposed on the DC voltage (peak – peak) in %.

For the operation of DC voltage switches, a filtered DC voltage with a ripple of 15% maximum is required.

Key to Symbols

Maximum load through switch	=	I_m
Load current	=	I_L
Supply voltage	=	V_s
No load current	=	I_o
Voltage drop across switch	=	V_d
Voltage across load	=	V_L
Effective collector load resistance	=	R_a
Load resistance	=	R_L
Number of switches	=	n

Model Numbers and Ordering

To order a cylinder with End of Stroke position switches, the standard model code from the appropriate cylinder catalogue should be used. In the 'special features' section of the code, an 'S' should be inserted and the following information included after the model code:

End of Stroke position switch(es); end(s) required; position(s); optional connector(s) PS012 if required

Note that, if a position switch is required in position 1, the revised port position must be specified in the model code.

Example

An HMI cylinder with End of Stroke position switches and standard connectors in position 1, ports in position 3 and air bleeds in position 4:

100 C JJ HMI R N S 1 4 M C 250 M 33 44
S = End of Stroke position switches at both ends in Pos'n 1

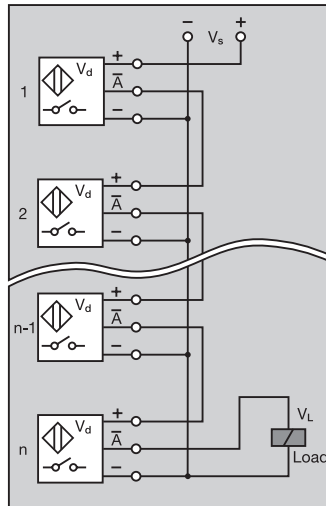
Series and Parallel Connection

Parker's End of Stroke position switches may be connected in series, to give an AND function; or in parallel, giving an OR function. The maximum number of switches which may be connected, in series or in parallel, depends on the external load requirements. Calculation of maximum numbers is described below.

Series Connection (AND Circuit)

The number of position switches which may be connected in series is limited by two factors – voltage drop and available current.

A voltage drop of approximately 1.5 volts occurs across each switch, therefore the output voltage available at the load is reduced by $1.5V \times$ the number of switches in series. In addition, each switch must supply the no-load current of all the other switches, as well as the load current, thus the sum of all the no-load currents, plus the external load current, must not exceed the current of a single switch. The maximum number of switches permissible is determined by whichever approach results in a lower number.

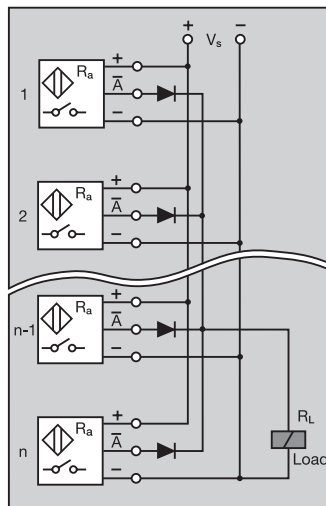


Parallel Connection (OR Circuit)

There is no limit to the number of switches which may be connected in parallel, provided that isolating diodes are fitted externally to the output of each switch, as indicated.

Where connectors with LED indicators are used, external isolating diodes must be fitted to prevent all of the LEDs from illuminating when one switch is actuated.

If external diodes are omitted, the number of switches is limited because each switch would have to drive the internal collector load of all other switches, as well as the external loads.



Calculation Examples

These show how to determine the number of switches (n) which may be connected in series or parallel for a given voltage supply and output loading. The examples use the following values:

Supply voltage V_s	24V
Min. voltage across the load V_L	18V
Load resistance R_L	360 Ω
Output resistance R_a using standard connector	2.2k Ω

Therefore:

Min. external load current $I_L = V_L/R_L$	50mA
Max. switch load current $I_m = 5 \times V_s$ (see Specification, page 6)	120mA

Example – for Series Connection

a. Voltage relationship is $V_s - n \times V_d \geq V_L$

Therefore number of switches $n \leq \frac{(V_s - V_L)}{V_d}$
 $n \leq \frac{(24 - 18)}{1.5}$

Therefore maximum number of switches = 4

b. Current relationship is $I_m \geq I_L + nI_o$

$$n \leq \frac{(I_m - I_L)}{I_o}$$

$$n \leq \frac{(120 - 50)}{10}$$

Therefore maximum number of switches = 7

Using the lower of the two results shown above, the maximum number of switches which can be connected in series is four.

Example – for Parallel Connection

If external diodes are fitted, the number of switches is limited only by the power supply. Where external diodes are not fitted, the following current formula applies.

Current relationship is $n \frac{V_s}{R_a} + \frac{V_s}{R_L} \leq I_m$

Therefore $n \leq (I_m - \frac{V_s}{R_L}) \frac{R_a}{V_s}$

$$n \leq \left(\frac{120}{1000} - \frac{24}{360} \right) \frac{2.2 \times 1000}{24}$$

$n \leq 4.9$

Rounding down, the maximum number of switches which can be connected in parallel = 4

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